User Manual for

ECK40-E and ECB40-PGE



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1. Product Overview

1.1.Product Introduction

The ECK40-E series core board of EBYTE is carefully designed based on Rockchip's RK3562 series processor. It adopts a brand-new stamp hole + LGA interface. Commonly used function I/O is designed on the stamp hole pins. When only commonly used function I/O is used, only the stamp hole pins need to be soldered.

The ECK40-E series core board is a fully domestically produced industrial-grade embedded core board characterized by its small size, high reliability, high energy efficiency, and cost-effectiveness. This core board can be widely used in the Internet of Things (IoT), automation control, intelligent manufacturing, self-service terminals, and other e-commerce and industrial equipment fields.

Rockchip's RK3562 is a high-performance, low-power quad-core application processor. This chip features multiple embedded hardware acceleration engines, effectively optimizing performance in high-end application scenarios. It supports near-full-format audio and video encoding and decoding capabilities, specifically including H.264 decoding at 1080p@60fps, H.265 decoding at 4K@30fps, and H.264 encoding at 1080p@60fps. It also incorporates a high-quality JPEG encoding and decoding module.

At the graphics processing level, the RK3562 integrates an embedded 3D GPU that is fully compatible with mainstream graphics standards such as OpenGL ES 1.1/2.0/3.2, OpenCL 2.0, and Vulkan 1.1; coupled with a dedicated 2D hardware acceleration engine, it can significantly improve display performance and ensure smooth system operation.

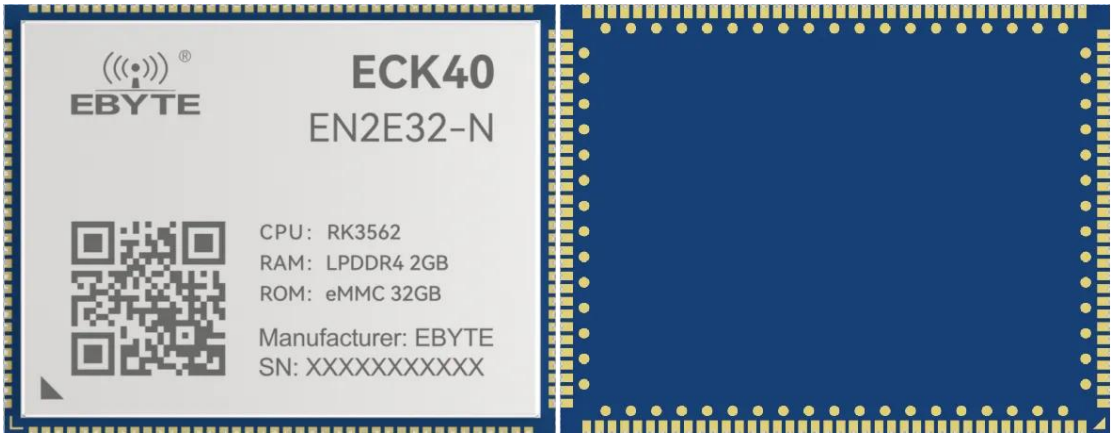
In addition, the chip's built-in neural network processor (NPU) supports mixed computation of INT4/INT8/INT16/FP16 multi-precision data and has good compatibility with mainstream deep learning frameworks such as TensorFlow, MXNet, PyTorch, and Caffe, which can easily complete the migration and deployment of network models.

The ECK40-E series core boards include various specific product models, all designed using domestically produced industrial-grade components. They differ primarily in operating temperature range and memory capacity configuration; customers can choose the appropriate model based on their needs. See the product selection section for detailed product selection

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information.

The following is a physical image of the ECK40-E series core board (without components on the bottom):



Core board physical image

1.2.Features

1. Processor: Rockchip RK3562 series processor;
   - Quad-core ARM Cortex-A53 (64-bit) processor with a maximum clock speed of 2.0GHz;
   - ARM Cortex-M0 MCU, maximum clock speed 200MHz;
2. Memory: Onboard 2GB LPDDR4 memory (other capacities can be customized);
3. Storage: Onboard 32GB eMMC (other capacities can be customized);
4. Video output:
   - 1x RGB parallel display interface, supporting a maximum resolution of 2048x1080@60fps;
   - 1 x LVDS display interface, supporting a maximum resolution of 800x1280 at 60fps;
   - 1 x 4-lane MIPI DSI display interface, supporting a maximum resolution of 2048x1080 at 60fps;
5. Video input:
   - 2x 4-lane or 4x 2-lane MIPI CSI display interfaces, supporting a maximum speed of 2.5Gbps per lane;
6. Audio:
   - 3x SAI, supports I2S, PCM, TDM, maximum sampling rate 192KHz;

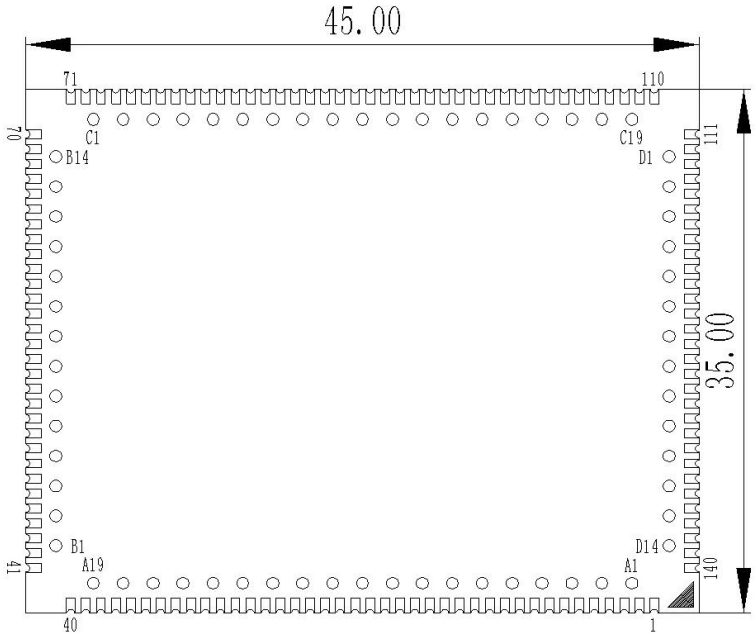
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- 1x SPDIF;
- 1x PDM, supports up to 8 channels, maximum sampling rate 192KHz;
- 1x Single-ended or differential Micro-phone input (derived from RK809);
- 1x class-AB PA to drive Headphone output (derived from RK809);
- 1x class-D PA to drive speaker output (derived from RK809);

7. Memory interface: 2x SDMMC interfaces;
8. Network controller:
   - 1 x 100Mbps MAC, 10/100 Mbps RMII interface;
   - 1x Gigabit GMAC, 10/100/1000 Mbps RGMII and RMII interfaces;
9. USB interface:
   - 1x USB 2.0 HOST;
   - 1x USB 2.0 OTG;
   - 1 x USB 3.0 HOST/PCIe 2.1 multiplexed interface, only supports PCIe x1 RC mode;
10. SPI controllers: 3x SPI controllers, each supporting two chip selects;
11. I2C Master: 6x I2C Master, supporting standard mode Kbit/s and fast mode 400Kbit/s;
12. UART (serial port): 10x UART, maximum supported baud rate of 4Mbps;
13. PWM (Pulse Width Modulation): 16x PWM, 32-bit timer/counter;
14. CAN controllers: 2 x CAN controllers, supporting CAN 2.0B protocol;
15. DSMC interfaces: 1 x DSMC Master and 1 x DSMC Slave interface;
16. FLEXBUS: 1x FLEXBUS (flexible parallel bus, which can connect to FPGA, external storage, etc.).
17. SARADC: 16x single-ended input ADC, 10-bit resolution, maximum sampling rate of 1MS/s;
18. GPIO: Supports up to 86 GPIOs and GPIO interrupts;
19. power supply:
    - One DC +5V±10%@1A power input;
    - 1-channel DC+3.3V@500mA power output (DC-DC output, VCC_3V3);
    - 1-channel DC +3.3V@100mA power output (LDO output, VCCIO_ACODEC);
20. Interface type: 140 PIN stamp hole + 66 PIN LGA;

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21. PCB dimensions: 45×35×1.6mm, as shown in the image below:

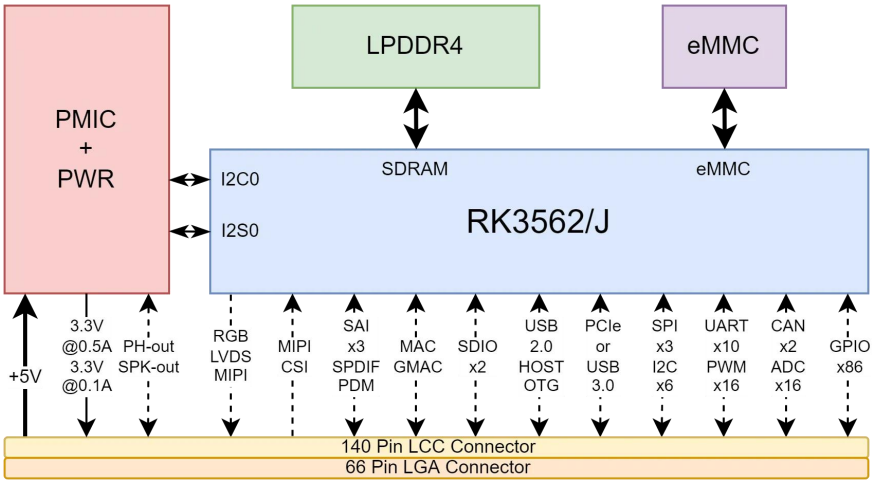


Dimensional diagram

22. Operating temperature: -25℃ to 85℃ / -40℃ to 85℃;

23. PCB process: 10-layer board design, immersion gold plating, lead-free process;

1.3.Core board functional block diagram



Core board functional block diagram

1.4.Typical applications

- Smart home;
- Smart toys;

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- Smart cities;
- Tablet PC ;
- IoT gateway ;
- Advertising all-in-one machine ;
- Industrial all-in-one PCs ;
- Industrial control motherboard;
- Robots and drones.

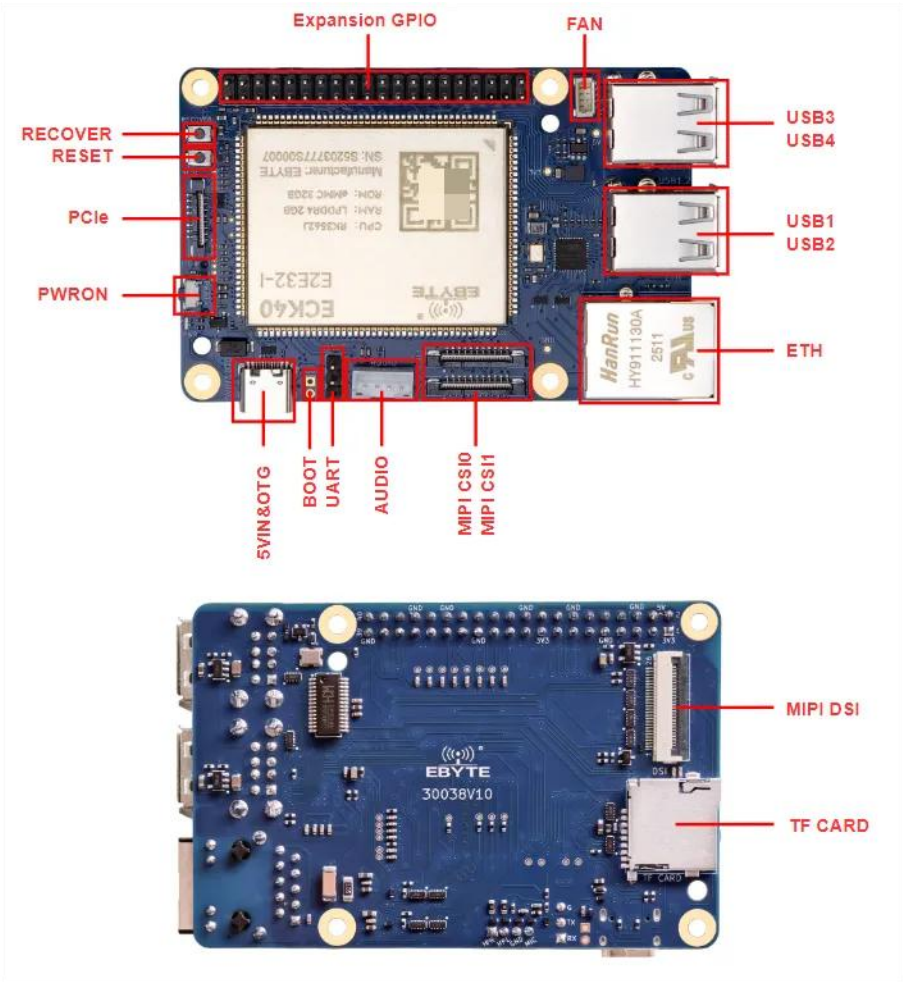
1.5.Matching single-board computer

EBYTE has launched the ECB40-PGE single-board computer based on the ECK40-E series core board. The core board is a 206-pin stamp hole + LGA package, which can be soldered to the baseboard via SMT. The baseboard design makes full use of the core board's interfaces, bringing out interfaces including MIPI DSI display interface, MIPI CSI camera interface, USB 2.0, USB OTG, SDIO, debug interface, Ethernet interface, audio interface, PCIe interface, FAN heatsink interface, and a wealth of expansion GPIO interfaces. The design level of this single-board computer is higher than that of ordinary development boards, and it can not only be used for core board functional verification, but also directly applied in batch industrial scenarios.

EBYTE provides stable reference designs and a comprehensive software development environment, offering users hardware design documents, software development manuals, and open-source baseboard schematics, package files, and PCB design files. This effectively helps users verify core board functionality, improve development efficiency, shorten development cycles, optimize design quality, and accelerate product development and time-to-market.

The functional diagram of the single-board computer is as follows:

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2. Product Selection

2.1.Model Configuration

The ECK40-E series core board selection and configuration table is as follows:

Core Board Product Selection and Configuration Table

Serial Number	Product Model	Processor Model	Memory	Storage	Operating temperature
1	ECK40-E2E32-I	RK3562J	2GB LPDDR4	32GB eMMC	-40℃ ~ 85℃
2	ECK40-EN2E32-N	RK3562	2GB LPDDR4	32GB eMMC	-25℃ ~ 85℃

The ECB40-PGE series single-board computer selection and configuration table is as follows:

Single-board computer product selection and configuration table

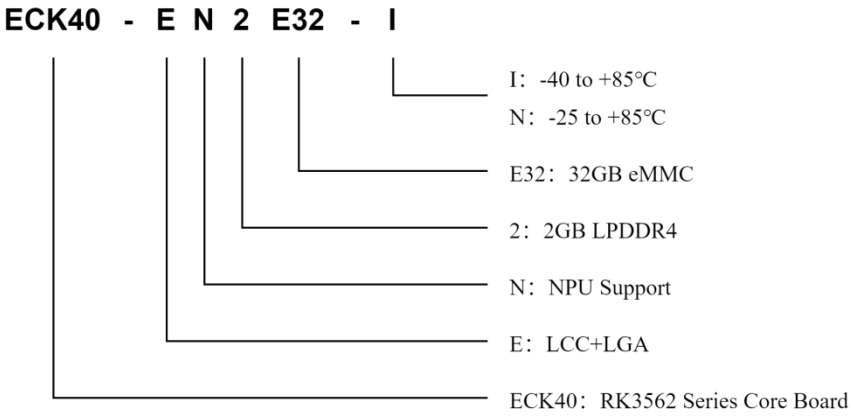
Serial Number	Product Model	Core board model	Memory	storage	Operating temperature
1	ECB40-PGEN2E32-N	ECK40-EN2E32-N	2GB	32GB	Domestic

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			LPDDR4	eMMC	wide temperature range -25℃ ~ 85℃
2	ECB40-PGE2E32-I	ECK40-E2E32-I	2GB LPDDR4	32GB eMMC	Domestic industrial grade -40℃ ~ 85℃

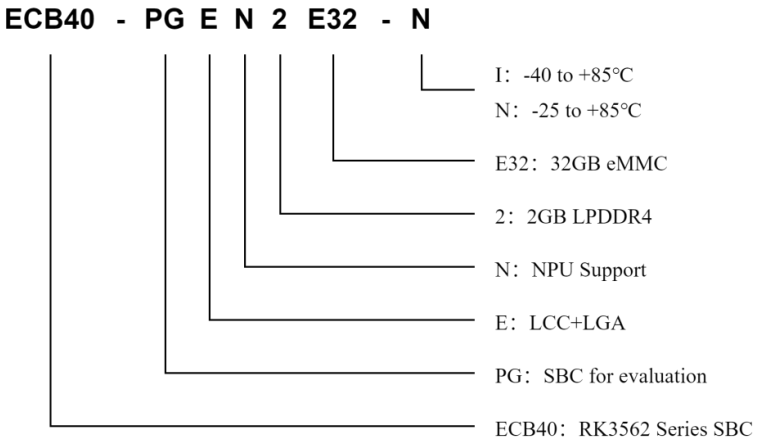
2.2.Model code

The core board product model code explanation is shown in the following figure:



Core board model code explanation

The product model coding explanation for single-board computers is shown in the following figure:



Single-board computer model coding explanation

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3. Functions and parameters

3.1.Core board product functions

The ECK40-E series core board integrates a processor, DRAM memory, eMMC storage, and power system, and exposes all I/O pins of the processor. Based on this core board, users only need to design a specific baseboard to flexibly configure I/O resources into the required functional interfaces, significantly reducing the hardware development threshold and accelerating product prototype verification and deployment.

The table below lists the main functional parameters integrated into the ECK40-E series core board, as well as the functional parameters of reusable I/O resources. The description of each I/O function is the maximum performance that the core board can achieve with that I/O function without using other I/O functions (for example, after using the 24-bit color RGB interface function and the network interface function, the full UART function cannot be implemented).

Core Board Product Function Table

Function	Function description
CPU	RK3562J/RK3562, 22nm; Quad-core ARM Cortex-A53(64bit), up to 2.0GHz; ARM Cortex-M0 MCU, up to 200MHz; NPU, up to 1 TOPS (RK3562J not support); GPU, Mali-G52-2EE;
MEM	On board 2GB LPDDR4;
FLASH	On board 32GB eMMC;
Video Engine	H.265 decoder up to 4K@30fps; H.264 decoder up to 1080P@60fps; JPEG decoder up to 65536x65536; H.264 encoder up to 1080P@60fps; JPEG encoder up to 8192x8192;
Video Output	1x RGB Parallel interface, up to 2048x1080@60fps; 1x LVDS interface, up to 800x1280@60fps; 1x 4-lane MIPI DSI interface, up to 2048x1080@60fps;
Video Input	2x 4-lane or 4x 2-lane MIPI CSI V1.2, up to 2.5Gbps per lane;
Audio	3x SAI, support I2S, PCM, TDM, sample rate up to 192KHz; 1x SPDIF; 1x PDM, up to 8 channels, sample rate up to 192KHz;

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	1x single end or differential mode Micro-phone input (RK809); 1x class-AB PA to drive Head-phone output (RK809); 1x class-D PA to drive speaker output (RK809);
SDMMC	2x SDMMC;
MAC	1x MAC, 10/100 Mbps port with RMII interfaces; 1x GMAC, 10/100/1000 Mbps port with RGMII and RMII interfaces;
USB 2.0 HOST	1x USB 2.0 HOST;
Multi-PHY	1x USB 2.0 OTG; 1x USB 3.0 HOST/PCIe 2.1, one lane, RC mode only;
SPI	3x SPI Controller, two chip-select per SPI;
I2C	6x I2C Master, standard mode 100Kbit/s and fast mode 400Kbit/s;
UART	10x UART, up to 4Mbps baud rate;
PWM	16x on-chip PWM, embedded 32bits timer/counter;
CAN	2x CAN controllers, support CAN 2.0B protocol;
SARADC	16x single-ended input, 10bits resolution, up to 1MS/s;
GPIO	86x GPIO, Supports Interrupt input;
Power input	DC +5V@1A;
Power output	DC +3.3V@500mA(VCC_3V3);
Power output	DC +3.3V@100mA (VCCIO_ACODEC);
Temperature	Operating Temperature: -25 to +85 °C / -40 to +85 °C;
Dimensions	45 x 35 x 1.6mm;
Interface type	140-PIN stamp hole + 66-PIN LGA
PCB technology	10-layer board design;

3.2.Single-board computer product functions

Single-board computer product function table

Power input	DC+5V±10%@2A Type-C interface;
MIPI DSI	One 4-lane MIPI DSI interface, supporting 2048x1080@60fps;

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MIPI CSI	Two 22-pin, two-lane MIPI CSI camera interfaces, supporting camera power control;
PCIe	One-way Raspberry Pi 5B compatible PCIe interface ;
USB HOST	4-channel USB 2.0 host;
USB OTG	One USB 2.0 OTG port with a Type-C interface, shared with the power input, and only supports Device mode;
Ethernet	One 10/100/1000M adaptive RJ45 Ethernet port;
TF card	One TF card slot, supporting insertion/removal detection;
Audio	One HPOUT output and one MICIN input are brought out using 3-pin PH2.0 interfaces respectively;
Debug	1-channel 3-pin TTL debug serial port;
GPIO	One set of 2.54mm 2x20 Pin standard RPI expansion interface, providing 3.3V and 5V power output, a total of 28 GPIO ports, multiplexing 1 set of SPI interface, 1 set of CAN interface, 1 set of I2S interface, 2 sets of I2C interface, and 3 sets of UART;
Button	One RESET button; One PWRON button; One RECOVER button; One BOOT button is brought out through one 1*2P-2.0mm pin header hole. The pin header is not soldered by default.
Indicator lights	One red-green dual-color indicator light, including power and operation indicators;

3.3.Environmental characteristics

Environmental Characteristics Table

Operating temperature	Wide temperature range	-25℃ ~ 85℃
	Industrial grade	-40℃ ~ 85℃
Storage temperature	-40℃ ~ 85℃;	
Operating humidity	5~95% humidity, non-condensing;	
Storage humidity	60℃@95% humidity, non-condensing;	

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3.4.Power consumption

Note: The following parameters were measured under normal temperature conditions on an ECB40-PGEN2E32-N single-board computer. Measurements were performed with a Linux system running on a TF card, running a stress test program under heavy power consumption, without a display screen, and connected to a single network. Test methods, usage functions, ambient temperature, and other factors can all affect power consumption; the following power consumption data is for reference only.

Power consumption meter

Power status	Test environment	Core board power consumption	Base plate power consumption
U-boot	U-boot state, unbooted kernel	0.738 W	1.353 W
Normal	No applications are running after system startup.	0.528 W	1.103 W
stress	Software reload testing	2.486 W	2.824 W
Freeze	Freeze mode sleep state	0.432 W	0.468 W
Mem	mem mode sleep state	0.055 W	0.105 W
Poweroff	Software shutdown	0.040 W	0.085 W

4. Software Resources

The ECK40-RK3562 series core board is equipped with an operating system based on the Linux 6.1.84 kernel. The development board comes with a cross-compilation toolchain, U-boot source code, Linux kernel and driver module source code, and various development and debugging tools suitable for Windows and Linux desktop environments.

Operating system:

Linux file system built with Buildroot 2024.02

System source code:

u-boot 2017.09

Kernel 6.1.84

Buildroot 202402

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Yocto

Development environment and tools:

USB burning tool: RKDevTool

SD card burning tool: SDDiskTool

4.1.System Resources

System Software Resource Table

Category	Name	Describe	Source code
RKBIN	rkbin	Firmware provided by rock-chip	<SDK>/rkbin
BOOT	u-boot 2017.09	bootloader	<SDK>/u-boot/
Kernel	Kernel 6.1.84	Linux kernel	<SDK>/kernel-6.1/
Device Driver	Audio	Built-in audio codec driver	sound/soc/codecs/rk817_codec.c
	Thermal	Tsadc temperature sensing driver	drivers/thermal/rockchip_thermal.c
	FIQ-Debugger	Debugging serial port driver	drivers/soc/rockchip/fiq_debugger/rk_fiq_debugger.c
	FSPI	SPI driver	drivers/spi/spi-rockchip.c
	MMC	MMC interface driver	drivers/mmc/host/dw_mmc-rockchip.c
	PWM	PWM driver	drivers/pwm/pwm-rockchip.c
	PMIC	Power management driver	drivers/mfd/rk808.c
	SARADC	SARADC driver	drivers/iio/adc/rockchip_saradc.c
	USB-PHY	USB PHY driver	drivers/phy/rockchip/phy-rockchip-inno-usb2.c
	GMAC	GMAC driver	drivers/net/ethernet/stmicro/stmmac/dwmac-rk.c
	Display	Display frame driver	drivers/gpu/drm/rockchip/rockchip_drm_drv.c
	VOP	Display output management driver	drivers/gpu/drm/rockchip/rockchip_vop2_reg.c
	DSI	DSI drive	drivers/gpu/drm/rockchip/dw-mipi-dsi-rockchip.c
	I2C	I2C driver	drivers/i2c/busses/i2c-rk3x.c

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	UART	Serial port driver	drivers/tty/serial/8250/8250_dw.c
	CAN	CAN driver	drivers/net/can/rockchip/rk3562_can.c
	PCIe	PCIe bus driver	drivers/pci/controller/dwc/pcie-dw-rockchip.c
	ISP	RK ISP driver	drivers/media/platform/rockchip/isp
	CIF	RK CSI platform driver	drivers/media/platform/rockchip/cif/
	CSI PHY	CSI PHY driver	drivers/phy/rockchip/phy-rockchip-csi2-dphy-hw.c
	SAI	SAI driven	sound/soc/rockchip/rockchip_sai.c
	Pinctrl	Pinctrl driver	drivers/pinctrl/pinctrl-rockchip.c
Operating system	Buildroot	Buildroot 202402	<SDK>/buildroot
	Debian	debian	<SDK>/debian
	Yocto	Yocto 5.0.3	<SDK>/yocto
Development tools	RKDevTool	USB burning tool	/tools/windows/RKDevTool
	SDDiskTool	SD card burning tool	/tools/windows/SDDiskTool

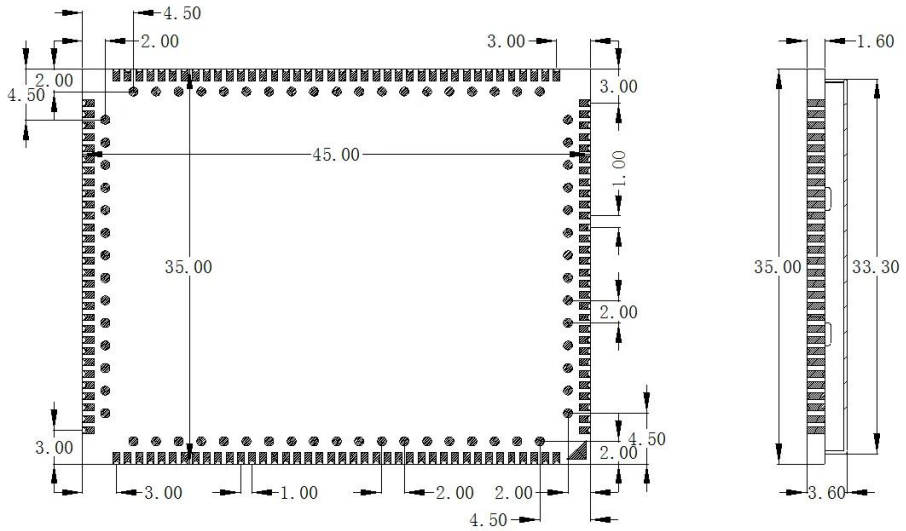
5. Structural dimensions

5.1.Core board structural dimensions

The ECK40-E series core board adopts an innovative 140-pin stamp hole + 66-pin LGA interface configuration. Commonly used function I/O interfaces are located on the stamp hole pins; if only some commonly used functions are used, only the stamp hole pins need to be soldered. The bottom layer of the core board has no components and no exposed traces, resulting in a simple baseboard design.

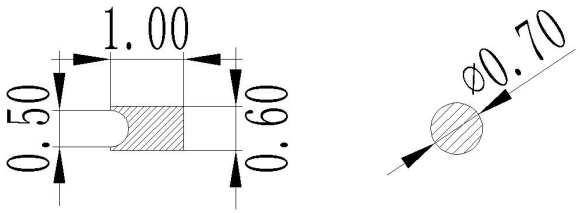
The ECK40-E series core board is 45.0mm long and 35.0mm wide. See the diagram below for structural dimensions. All dimensions are in millimeters (mm). Dimensional tolerance is ± 0.1mm, and PCB thickness tolerance is 10%.

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Core board structural dimensions diagram

The dimensions of the stamp holes and LGA pads on the bottom surface of the ECK40-E series core board are shown in the figure below. The units for the following dimensions are millimeters (mm).

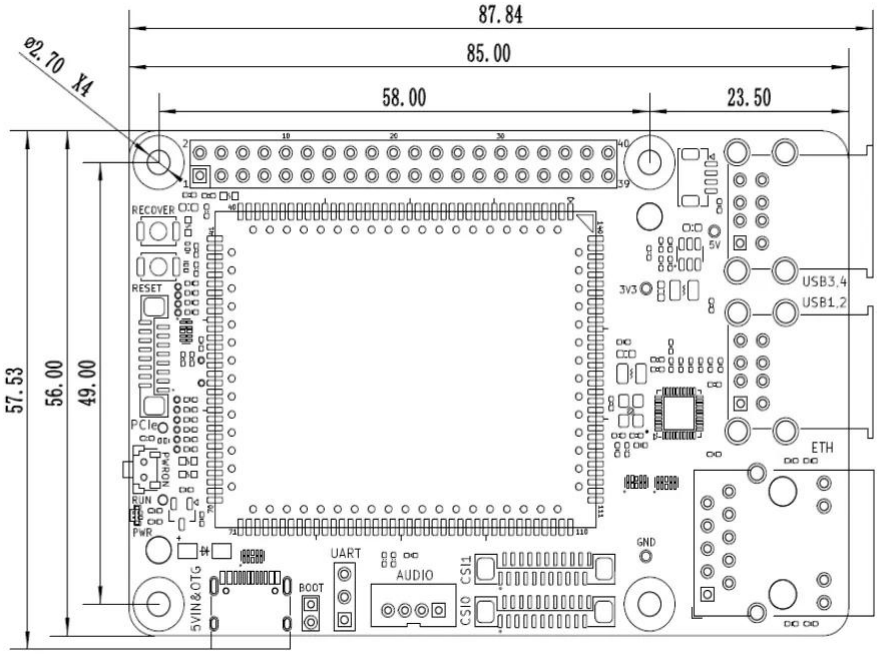


Core board pad dimension diagram

5.2.Single-board computer structural dimensions

The ECB40-PGE series single-board computer is 100.0mm long and 72.0mm wide, compatible with 2.5-inch boards. See the diagram below for structural dimensions. All dimensions are in millimeters (mm). Dimensional tolerance is ±0.1mm, and PCB thickness tolerance is 10%.

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Single-board computer structural dimension diagram

6. Core board welding instructions

6.1.Reflow soldering temperature

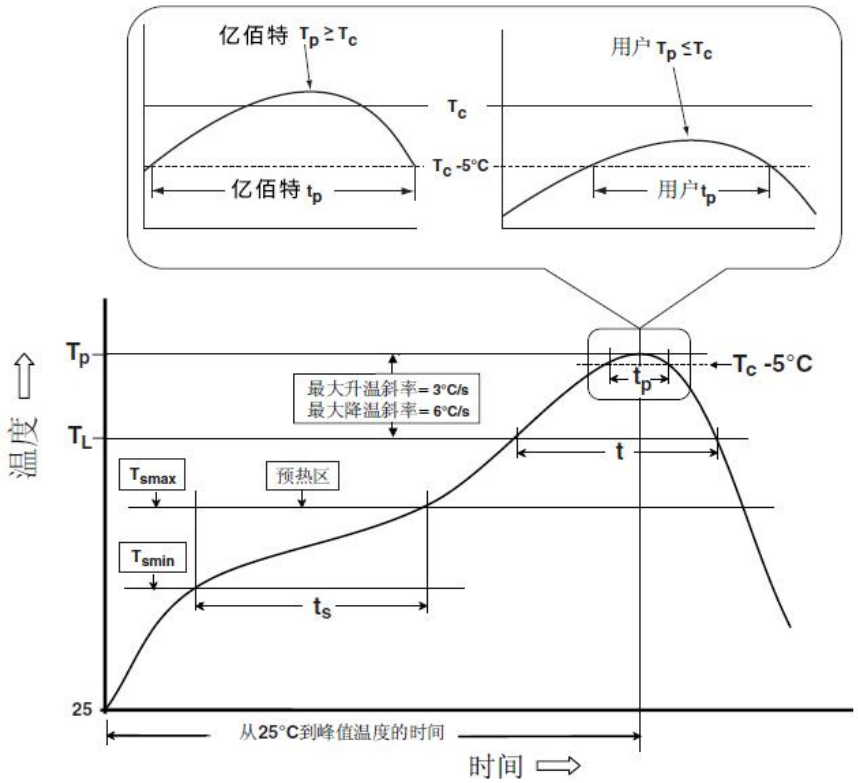
Reflow soldering temperature gauge

Reflow soldering profile characteristics		Lead-based assembly	Lead-free assembly
Preheating/Insulation	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (Tsmax)	150℃	200℃
	Time (Tsmin~Tsmin)	60-120 seconds	60-120 seconds
Temperature rise slope (TL~Tp)		3℃/second, maximum value	3℃/second, maximum value
Liquid phase temperature (TL)		183℃	217℃
Duration above TL		60~ 90 seconds	60~ 90 seconds
Package peak temperature Tp		Users must not exceed the temperature specified on the product's "humidity sensitivity" label.	Users must not exceed the temperature specified on the product's "humidity sensitivity" label.
The time (Tp) within 5° C of the specified grading temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (Tp~TL)		6℃/second, maximum value	6℃/second, maximum value

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Time from room temperature to peak temperature	6 minutes, the longest	8 minutes, the longest
* The peak temperature (Tp) tolerance of the temperature profile is defined as the user's upper limit.		

6.2.Reflow soldering curve



Reflow soldering curve

7. Revision Notes

Revision Notes

Version	Modifications	Modified time	prepared by	Proof reading	Approval
V1.0	First draft	2026-01-16	WFX	WJ	WFX

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